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Carbon, Carbon Everywhere But What About the Water?

by Tom Rooney, SPG Solar

Everybody's talking about carbon footprints. And how fossil fuels spew carbon into places where it probably should not be spewed. O.K.: We get it.

But despite all the attention directed at carbon, more and more scientists are starting to figure out that it takes so much water to create energy, and so much energy to move water, that whenever we talk about the carbon footprint of energy, we really should be talking about its water footprint as well.

That is because water and energy are linked, as the Bard said, "As two spent swimmers, that do cling together and choke their art." And until we recognize that connection, we will not be able to figure out how to get the most from our energy and our water.

The connection between most energy and water starts with one simple fact: Except for wind and photovoltaic solar found on rooftops, most power plants big or small do one basic thing: They boil water.

That's it.

The water then makes steam, which spins a turbine, which runs a generator, which creates electricity in a way that is almost miraculous. But with that miracle comes a price: Water. Lots and lots of it.

No matter if it is coal-powered, or nuclear, or oil or even large-scale solar thermal, all that heat has to be cooled down.

Thus the water. And when it is used for cooling, some of it is lost. It takes at least one gallon of water to create one kilowatt hour of power — enough to run your air conditioner for one hour. That water is consumed, not just used.

The numbers tell the tale: Rachelle Hill and Dr. Tamim Younos of Virginia Tech University estimate that "fossil fuel thermoelectric plants use between... 8 to 16 gallons of water to burn one 60-watt light bulb for 12 hours per day. Over the duration of one year this one incandescent light bulb would consume about 3,000 to 6,300 gallons of water."

That's a lot of water for a little bit of energy.

Other household appliances are just as thirsty: A central air conditioner running for 12 hours a day will drink up 16,800 gallons of water every year at the power plant. A laptop computer uses 200 gallons a year. A coffee maker perking two hours a day needs 672 gallons of water every year to brew that cup of Joe.

Different types of power plants require different amounts of water. The Department of Energy says coal and oil plants need about a gallon or two per kilowatt-hour (kWh). Hydro plants in the Northwest, for example, need 18 gallons for the same amount of energy. Power plants in Arizona use 7 gallons per kWh. In South Dakota, the Department of Energy says the average is 72 gallons of water per kWh. In California, its 4.5 gallons of water per kWh.

These numbers are all about water that is consumed — not just withdrawn. In California, 49 percent of all the water withdrawn in the state is used for energy.

Much of the water used to cool power plants is returned to the river or ocean whence it came, true enough. But not before killing billions and billions of fish and marine mammals every year. Not before a lot of it evaporates.

All that happens just at the power plant. And it is happening all over the country all the time. Just Google 'power plant fish kill' and insert the name of your favorite state for numbers near you.

Take one step back from the power plant to the mine or the oilfield, and every day, billions of gallons of water are consumed coaxing energy from beneath the earth.

The amount varies from the one gallon of water it takes to extract a gallon of oil from conventional means, to up to 350 gallons of water for every gallon when the oil is harder to find.

In December 2008, 1.2 billion gallons of water and coal ash escaped from a burst dam in Tennessee. If you want to figure out how much water it will take to get rid of what we now know to be the largest industrial spill in history, or how much water was spoiled once it came in contact with this material, good luck.

To paraphrase a popular saying: it only takes an ounce of water and coal ash to ruin a gallon of ice cream.

For my entire professional career, I've been involved in building water and energy infrastructure. I've spoken all around the world including China and India, on water and sewer infrastructure as well as the water-energy connection. I've also written about it for hundreds of newspapers from the New York Times to the Los Angeles Times. I mention this because I have at times been a bit surprised at the reaction of some folks when they hear people talk about the connection between water and energy.

A newspaper columnist in New Jersey said they had all the water they could ever want and so they did not have to worry about my so called water and energy connection. A network news science reporter saw my articles calling attention to the water energy connection as some kind of global warming plot — which he did not approve of.

And so the science — the civil engineering — is politicized to the point where some folks who should know better try and deny the obvious.

Let's add this to the obvious: Clean water is a scarce and valuable commodity -- the scarcity of which is killing millions of people every year, and making tens of millions more sick.

These are the stakes of the water and energy connection. And we should not forget or deny them.

The water it takes to create energy is still only half the picture. It also takes a tremendous amount of energy to move, treat and ultimately dispose of water.

In California, 20 percent of the energy in the state is used to move water. We use water to create energy, and we use energy to create water — to create more energy to create more water. And on and on and on it goes in a downward spiral — like the “two spent swimmers that cling together” — that completely distorts the way we think and act about water and power. Whenever we waste energy, we waste water.

Big transmission lines, for example, which carry energy from the thirsty power plants to energy-hungry refrigerators and light bulbs hundreds of miles away leak energy like a sieve. They lose 7 percent of their juice before lighting a single bulb.

That's not just wasting power, its wasting water too.

Not all power plants create heat. Photovoltaic solar panels — the kind found on roofs and backyards and schools and wineries and farms and roads and office buildings and hotels — create electricity, not heat.

And that is why a growing number of governments, businesses and even utilities are taking a more serious look at photovoltaic solar PV as a safer, more secure and more water-smart energy alternative.

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